

Atlantic, where it has been traced as number 7 of North Atlantic storms. Descriptions of the storms and high tides attending this depression, as noted at Signal Service stations, are given under the heading "Local storms."

V.—This storm has been previously referred to as a secondary disturbance attending the severe storm traced as number ii on the Pacific coast. It developed in the central Rocky Mountain regions, and was first located on the morning of the 14th as central in eastern Colorado. In this connection it may be well to note that the morning weather map of the 14th exhibited four separate storms—one on the north Pacific coast, one in the central Rocky Mountain region, one off the Florida coast, and the fourth over the Maritime Provinces. Number v moved southeasterly during the 14th, the centre passing over Indian Territory, after which it moved to the Mississippi Valley as an extended barometric trough covering the central valleys, the centre apparently moving to the northeastward attended by a loss of energy and increasing pressure at the centre of the disturbance. It disappeared during the 16th while central in the upper Mississippi Valley, without causing any marked change in the weather conditions to the eastward. It should also be noted that the minimum barometric pressure within each of the four areas central within the limits of the weather map on the 14th was recorded on that date.

VI.—Number vi developed in the central Rocky Mountain region on the 16th in the southeastern portion of a barometric trough which passed eastward from the Pacific, the principal disturbance apparently passing north to British Columbia, while this storm moved southeasterly, developing considerable energy as it passed from Colorado to the lower Mississippi valley. The winds attending this storm were unusually strong on the eastern slope of the Rocky Mountains south of the Missouri Valley, and heavy rains with severe local storms occurred on the 17th from Kansas and Missouri southward to Texas. After reaching latitude N. 35° the storm moved eastward over the Gulf and south Atlantic states, attended by general rains south of the Lake region, the centre probably reaching the Gulf Stream on the 19th, where it moved northeasterly and continued its course as number 9 of the storms of the north Atlantic.

VII.—The weather map of 8 a. m. of the 20th exhibited a barometric depression extending from the Rio Grande Valley northward to British America, with indications that a storm-centre was approaching from the region north of Dakota. The 8 p. m. weather chart of the same date exhibited a well-defined depression central in western Texas, which was apparently being forced southeasterly by an area of high pressure then central on the north Pacific coast. This storm continued its course southeasterly to the Gulf coast where it changed its course to northeast during the 22d, attended by heavy rains in the lower Mississippi valley and strong northerly winds on the Texas coast after the centre had passed over Louisiana. Strong southeasterly gales were also reported on the east Gulf coast on the morning of the 24th. After passing inland the winds diminished in force and it moved off the North Carolina coast as a disturbance of slight energy, although the reports from the Atlantic and from Sydney, C. B. I., of the 26th indicate

that it was attended by severe gales after it left the coast.

VIII.—This was a slight disturbance which was central north of the Lake region on the 26th, although the preceding weather map exhibits a slight disturbance west of Lake Superior. It moved southeasterly to Lake Huron, the pressure decreasing at the centre during the movement, attended by brisk to high westerly winds over the Lake region on the 27th. From Lake Huron it passed easterly, inclining to the lower Saint Lawrence valley, this movement being followed by showers over the eastern portion of the country as far south as Tennessee and North Carolina. It extended in area as it approached the Atlantic, and was followed by a secondary disturbance which developed in the upper Saint Lawrence valley on the 29th.

IX and IX a.—The a. m. weather map of the 29th showed the presence of two areas of high pressure, the one covering the upper Mississippi and Missouri valleys, and the other the Pacific coast, while between these and over the Rocky Mountain regions the pressure was below 29.9, and in the regions north of Montana a well-marked area of low pressure had formed, the barometer reading 29.54 at Medicine Hat, N. W. T. and general rains were reported from the Rocky Mountains west to the north Pacific coast. This barometric trough moved slowly to the east, the storm-centre north of Minnesota inclining to the southeast, following the general course of the Missouri River, while a second disturbance (ix a) in the southern portion of this trough moved eastward over New Mexico and Texas, inclining to the northeast, the two disturbances uniting at the mouth of the Missouri on the morning of the 31st, forming an extended depression of an oval form, covering the country from the lower lake region southwest to Texas. At the close of the month this storm had reached the Atlantic coast, but the centre of disturbance was in the upper Ohio valley. During the passage of this low area over Texas strong gales occurred on the Texas coast, and the southerly winds reached a velocity of forty-eight miles per hour at Fort Sill, Ind. T., and Fort Elliott, Tex.

The following table exhibits the principal facts regarding these low areas:

No.	First observed.			Last observed.			Duration.	Velocity per hr.	Lowest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.				Date.	Station.	Reading.
I.....	1	0	97	0	60	Days.	Miles.	7		Portland, Maine.....	Inches.
II.....	11	43	126	50	125	8.5	16.0	14		Tatoosh Island, Wash..	28.79
III.....	12	53	98	50	59	3.5	6.5	14		Anticosti Id., G. of St. L.	29.18
IV.....	14	30	79	38	65	2.0	42.0	14		Anticosti Id., G. of St. L.	29.40
V.....	14	39	103	43	90	3.0	15.0	15		Charleston, S. C.....	29.52
VI.....	16	40	105	33	76	2.0	25.0	14		Hatteras, N. C.....	29.52
VII.....	20	34	105	36	77	3.0	26.0	17		Fort Elliott, Tex.....	29.28
VIII.....	26	50	88	51	65	5.0	20.0	25		Fort Sill, Ind. Ter.....	29.32
IX.....	29	50	110	40	83	2.0	30.0	28		Hatteras, N. C.....	29.56
IX a.....	30	36	108	39	91	2.0	34.0	29		Anticosti Id., G. of St. L.	29.53
						1.0	43.0	30		Medicine Hat, N. W. T..	29.54
										Fort Elliott, Tex.....	29.70
Mean.....						3.2	25.8				29.38

NORTH ATLANTIC STORMS FOR MARCH, 1889 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during March, 1889, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels, received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Twelve depressions have been traced, the average number traced over the north Atlantic Ocean for March during the last six years being ten. Of the depressions traced for March, 1889, five were continuations of areas of low pressure which

first appeared over the American continent; two were first noted south of the thirtieth parallel, from whence they moved northward; two appeared southeast, and one east, of Newfoundland, and two apparently developed east of the twenty-fifth meridian. The storms generally pursued normal east to northeast paths and were well distributed over the ocean.

Over and near the British Isles the weather continued generally stormy during the first decade of the month, and from the 18th to 20th, inclusive, the severest gales occurring on the 19th and 20th, when the barometric pressure fell to, or below, 29.00 (737). Over mid-ocean unsettled weather was almost

continuous from the 5th to 28th, with pressure below the normal and gales of varying force, the severest storms being noted on the 12th and 18th, when barometer readings falling to about 29.20 (742) were reported. West of the forty-fifth meridian the general character of the weather was stormy, the storms of the first decade being particularly severe, and the occasioning considerable loss and damage to shipping. The following report by Gen. Russell Hastings, voluntary observer at Hamilton, Bermuda, indicates the general character of the weather in that locality during the passage of low area i: "There has been during the past week a wonderful depression of barometric pressure. The highest barometer noted since March 1st was 29.92 (760), at 9 p. m., 3d. The pressure gradually decreased, and at 9 p. m. of the 4th had fallen to 29.78 (756). At 2 a. m. of the 5th the storm burst upon us from the sw., with light rain and very high winds. At 2 p. m. of the 5th the barometer recorded 29.31 (744), the lowest point reached since I have been taking observations (Sept. 1, 1888). At 3 p. m., 5th, the sky was clear, with a dead calm, but the barometer continued low. I am unable to say what the force of the wind was from 2 a. m. to 2 p. m. of the 5th, as there is no anemometer at this station, but I am quite sure I have seen a stronger wind here with barometer above 30.00 (762). Since the morning of the 5th light west winds have prevailed, with passing showers and bright sunshine, and frequently a clear sky. I judge a fearful cyclone has passed up the eastern edge of the Gulf Stream some two hundred or more miles west of here."

As compared with the corresponding month of previous years, March, 1889, was unusually stormy, more particularly over the western part of the ocean. The depressions, while exceeding in number the average for the month, were not of exceptional energy for the season and were chiefly characterized, as has been noted in preceding years, by their slow progressive movement, which resulted in long continued unsettled weather in the regions where they prevailed.

The following are brief descriptions of the depressions traced:

1.—The presence of a depression of considerable energy south-east of the Banks of Newfoundland was shown by reports of the 1st. By the 2d the centre of disturbance had apparently advanced north of west, with a marked loss of energy, after which it probably moved south of west and united with depression number 3 which had advanced from southeast of Bermuda.

2.—This was a depression of moderate energy whose centre was located west of the British Isles on the 1st and 2d, whence it apparently advanced eastward, attended until the 5th by fresh gales east of the twentieth meridian.

3.—This depression is first located in about N. 27°, W. 54°, under date of the 2d, whence it moved northwestward to the thirty-sixth parallel by the 3d, after which it recurved to the eastward and advanced to the British Isles by the 7th, attended throughout by fresh to strong gales and a gradual decrease in barometric pressure, the lowest barometer readings being shown to the southward of the British Isles on the 7th and 8th, when they fell to about 29.30 (744).

4.—This depression apparently advanced from the vicinity of the Azores to the Bay of Biscay from the 8th to 10th, inclusive, its centre being located about midway between the Azores and the British Isles at noon, Greenwich time, of the 9th. The depression possessed considerable energy, and appeared to move eastward over the continent of Europe after the 10th.

5.—This depression, a continuation of low area i, moved slowly northeastward from the south Atlantic coast (to which it had advanced from the west coast of the Gulf of Mexico) from the 3d to the 6th, inclusive, after which it recurved to the northwestward, and on the morning of the 7th was central off the middle New England coast with barometric pressure falling below 28.80 (732). After the 7th the centre of disturbance moved slowly east of north until the 9th, when it was located near Anticosti Island, Gulf of Saint Lawrence, and then recurved eastward over northern Newfoundland and apparently disappeared north of the region of observation after the 11th. This depression was attended by gales of great violence, which

wrought considerable destruction to shipping along and off the coast of the United States, the greatest barometric depression being shown on the 7th, after which a loss of energy was apparent, although strong gales continued off the American coast to the thirtieth parallel until the 12th. On the 6th, when the depression was central in about N. 40°, W. 66°, with pressure falling to, or near, 29.00 (737), the barometer reading at Saint John's, N. F., was 30.02 (763). It will be seen from these readings that at the time the storm-centre recurved to the northwest from a normal east-northeast course there was a barometric gradient of about one inch in 600 geographical, or about 700 statute, miles in its line of advance.

6.—This depression appeared east of the Grand Banks on the 12th, and was a subsidiary development to, or possibly a continuation of, depression number 5. By the 13th the storm-centre had moved eastward to the thirty-first meridian, after which it apparently moved northward and dissipated. On the 12th pressure falling to about 29.30 (744) and strong to whole gales were reported, after which a loss in energy was shown.

7.—This depression, a continuation of low area iv, moved slowly in a general northeast direction and disappeared over mid-ocean north of the fifty-fifth parallel after the 21st. From the 14th to 18th, inclusive, very severe gales attended the passage of this depression; subsequent to that date moderate to fresh gales were reported. From the 15th to 17th very high tides, which caused considerable damage to property, occurred along the middle Atlantic coast.

8.—This depression was a continuation of low area iii, and advanced eastward over the southern extremity of Newfoundland during the 14th. By the 18th the centre of depression had moved northeastward to the twenty-fifth meridian, after which it recurved southeastward and disappeared south of the British Isles after the 19th. The depression augmented in energy during its passage and on the 18th and 19th barometer readings, ranging below 29.00 (737), were reported south of the British Isles.

9.—This depression was a continuation of low area vi which advanced eastward from the south Atlantic coast during the 19th. Moving east-northeast the storm-centre disappeared over mid-ocean after the 23d. The gales attending this depression were quite severe, and on the 20th and 21st destructive high tides occurred from Norfolk, Va., to Long Island, N. Y.

10.—This depression moved north-northeast from southeast of the Banks of Newfoundland during the 24th and 25th, attended by moderate to fresh gales, after which it apparently passed northward beyond the region of observation.

11.—This depression was central on the 26th south of Newfoundland, with pressure falling to, or below, 29.10 (739), and strong to whole gales. By the 27th the storm-centre had advanced northeastward to the fortieth meridian, without evidence of diminished energy, after which it disappeared north of the region of observation.

12.—This was a depression of small energy which moved northeastward from the Gulf of Saint Lawrence over Newfoundland during the 30th.

OCEAN ICE IN MARCH.

The following table shows the southern and eastern limits of the region within which icebergs or field ice were reported for March during the last seven years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
March, 1882	42 30	50 00	March, 1882	46 30	46 00
March, 1883	41 46	49 48	March, 1883	48 40	43 03
March, 1884	41 20	54 06	March, 1884	45 00	40 15
March, 1885	40 55	49 04	March, 1885	45 57	43 15
March, 1886	40 20	49 02	March, 1886	47 20	44 40
March, 1887	41 00	49 07	March, 1887	45 31	42 56
March, 1888	42 30	50 37	March, 1888	47 23	46 56
March, 1889	44 20	53 00	March, 1889	44 20	53 00

No icebergs were reported for March, 1889. On the 2d the

s. s. "Devonia" encountered thin field ice in N. 44° 20', W. 53° 00', this being the only field ice noted during the month. The entire absence of icebergs, and the almost entire absence of field ice, over and near the Banks of Newfoundland during March, 1889, constitutes a noteworthy and very unusual feature, as during the corresponding month of the last seven years icebergs and field ice have been reported in large quantities in that region. During this period the average southern limit of ice for March has been about N. 41° and the average eastern limit about W. 44°.

OCEAN FOG IN MARCH.

Fog at Saint Johns, N. F., 1st, 2d, 3d, 4th, 6th, 7th, 8th, 20th, and 26th.

The limits of fog-belts west of the fortieth meridian are shown on chart i by dotted shading. In the vicinity of the Banks of Newfoundland fog was reported on seventeen days, as compared with thirteen days for February, 1889, and sixteen days for March, 1888. Between the fifty-fifth and sixty-fifth meridians fog was reported on twelve days, as compared with four days for February, 1889, and six days for March, 1888. To the westward of the sixty-fifth meridian fog was reported on seven days, as compared with three days for February, 1889, and six days for March, 1888. In each of the regions referred to the development of fog attended the approach or passage of areas of low barometric pressure, and the unusual

frequency of its occurrence may be attributed to the numerous and energetic storms which traversed the western portion of the ocean during the month.

The following are limits of fog-areas on the north Atlantic Ocean during March, 1889, as reported by shipmasters:

Date.	Entered.			Cleared.			Date.	Entered.			Cleared.		
	Lat. N.	Lon. W.		Lat. N.	Lon. W.			Lat. N.	Lon. W.		Lat. N.	Lon. W.	
2-3	44 00	56 00		41 50	63 00		16-17	40 35	65 40		40 50	64 00	
2-3	44 58	53 30		44 10	56 20		16-17	40 28	66 52		40 46	64 00	
2-3	40 09	66 08		39 41	69 39		16-18	40 39	65 30		42 04	58 00	
2-4	45 17	53 21		43 15	61 50		17	40 48	67 00		40 40	69 30	
3-4	40 52	67 50		40 30	69 00		17	41 07	65 55		40 34	70 00	
3-4	42 16	61 05		40 55	68 30		18	42 45	60 50		42 41	62 28	
3-4	43 00	60 00		42 10	63 40		18-19	44 05	52 06		43 06	58 29	
3-4	45 29	47 19		46 28	45 16		17-19	40 40	65 00		39 50	68 10	
4	42 07	52 24		42 53	49 07		18-19	44 10	48 29		43 06	52 16	
4-5	At Halifax, N. S.						19-20	44 39	52 00		43 18	57 57	
6	40 59	63 50		40 57	64 14		19-20	44 54	44 42		43 11	51 10	
6	42 09	51 00		42 00	50 00		20	45 40	46 48		45 02	49 00	
6-7	At Halifax, N. S.						20	43 04	52 57		43 02	54 06	
7-8	43 12	50 00		42 40	52 55		20-21	45 59	43 47		45 45	49 55	
7-8	43 22	48 20		42 43	50 00		25	43 40	50 30		44 50	48 05	
8	44 05	45 22		43 45	46 31		25	44 57	48 52		44 47	49 47	
8-9	47 06	46 26		44 53	51 17		25	35 43	73 50		35 45	73 48	
9	44 00	47 59		43 24	49 40		25-26	42 00	50 30		42 00	51 30	
9	44 40	53 25		45 20	51 00		29	44 50	60 00		44 50	62 00	
9-10	47 00	46 50		45 10	49 20		30	42 21	52 53		42 22	53 15	
9-10	46 30	48 10		47 15	46 00		30-31	42 57	50 40		42 44	52 22	

TEMPERATURE OF THE AIR (expressed in degrees, Fahrenheit).

The distribution of mean temperature over the United States and Canada for March, 1889, is exhibited on chart ii by dotted isotherms. In the table of miscellaneous meteorological data the monthly mean temperature and the departures from the normal are given for regular stations of the Signal Service. The figures opposite the names of the geographical districts in the columns for mean temperature show the averages for the several districts. The normal for any district may be found by adding the departure to the current mean when the departure is below the normal and subtracting when above.

The mean temperature was highest over the southern extremity of Florida, and in the lower valleys of the Colorado and Gila rivers, where the values rose above 65°. In Florida south of the thirtieth parallel, along the middle and west Gulf coast, in southwestern Arizona and southeastern California, and at stations in the valley and to the eastward of the San Joaquin River and Tulare Lake, Cal., the mean temperature was above 60°. The mean temperature was lowest north of a line traced through Minnedosa and Winnipeg, Manitoba, and thence eastward to the extreme northern shore of Lake Superior, where the readings were below 25°. Values below 32° were reported north of a line traced irregularly east-southeast from Qu'Appelle, N. W. T., to Lake Ontario, and thence north of east to Cape Breton Island. Within an area extending over adjoining portions of Arizona, New Mexico, Utah, and Colorado the means fell below 35°.

The mean temperature was below the normal south of a line traced from central Arizona eastward to middle Alabama, and thence northeastward to the Atlantic coast in about the latitude of southern Delaware, the greatest departures below the normal being noted in the lower Rio Grande valley, where they exceeded 5°. In all districts north of the line referred to and on the Pacific coast the month was warmer than the average March, the greatest departures above the normal being shown in northwestern Minnesota, northeastern Dakota, and southwestern Manitoba, where they were more than 15°. Over a greater portion of the country north of the fortieth parallel the temperature was 5°, or more, above the normal. On the Pacific coast the departures above the normal were less than 5°, except in the lower valley of the Columbia River.

The following are some of the most marked departures from the normal at the older established Signal Service stations:

Above normal.		Below normal.	
Saint Vincent, Minn.	16.4	Rio Grande City, Tex.	5.5
Bismarck, Dak.	15.2	Jacksonville, Fla.	3.9
Minnedosa, N. W. T.	15.0	Key West, Fla.	3.6
Marquette, Mich.	10.1	Galveston, Tex.	3.0
Portland, Oregon	5.8	Savannah, Ga.	2.7

DEVIATIONS FROM NORMAL TEMPERATURES.

The following table shows for certain stations, as reported by voluntary observers, (1) the normal temperature for a series of years; (2) the length of record during which the observations have been taken, and from which the normal has been computed; (3) the mean temperature for March, 1889; (4) the departure of the current month from the normal; (5) and the extreme monthly means for March during the period of observation and the years of occurrence:

State and station.	County.	(1) Normal for the month of March.	(2) Length of record.	(3) Mean for March, 1889.	(4) Departure from normal.	(5) Extreme monthly mean temperature for March.			
						Highest.	Year.	Lowest.	Year.
Arkansas.			Years	°	°	°		°	
Lead Hill.....	Boone.....	48.5	7	50.1	+1.6	55.4	1882	45.5	1885
California.									
Sacramento.....	Sacramento.	54.8	36	54.5	-0.3	59.8	1853	48.8	1880
Colorado.									
Fort Lyon.....	Bent.....	41.6	20	43.3	+1.7	47.3	1879	29.6	1867
Connecticut.									
Middletown.....	Middlesex.....	32.2	20	37.0	+4.8	40.7	1871	25.7	1872
Florida.									
Merritt's Island.....	Brevard.....	65.3	6	61.6	-3.7	71.1	1884	61.6	1889
Georgia.									
Forsyth.....	Monroe.....	56.9	15	57.4	+0.5	61.7	1880 '82	51.4	1885
Illinois.									
Peoria.....	Peoria.....	38.3	33	43.1	+4.8	45.8	1871	29.4	1867
Riley.....	McHenry.....	31.3	32	36.2	+4.9	41.7	1878	23.8	1872
Indiana.									
Vevay.....	Switzerland.....	42.6	22	45.9	+3.3	50.7	1878	35.7	1885
Iowa.									
Cresco.....	Howard.....	25.8	17	35.1	+9.3	42.3	1878	19.6	1888
Monticello.....	Jones.....	31.9	35	39.4	+7.5	45.8	1878	23.8	1867
Logan.....	Harrison.....	34.7	15	42.1	+7.4	48.0	1876	28.3	1875
Kansas.									
Lawrence.....	Douglas.....	42.3	25	41.6	-0.7	51.2	1866	34.2	1876
Wellington.....	Sumner.....	43.6	10	46.9	+3.3	49.6	1879	39.0	1883